THURSDAY, MAY 17, 1917.

ELEVEN BRITISH MATHEMATICIANS.

Mathematical Monographs. No. 17. *Lectures on Ten British Mathematicians of the Nineteenth Century*. By Alexander MacFarlane. Pp. 148. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 5*s*. 6*d*. net.

THE lives of mathematicians, as a rule, are free from sensational episodes, and provide no material for spicy biographies. But these unobtrusive beings form a quaint and varied set; and many people would be surprised to hear how many good stories are on record about their oddities, their accomplishments—nay, even their displays of wit.

The author of these lectures was himself a noteworthy man. A Highlander, and a pupil of Tait, he became an ardent quaternionist, and helped to found the International Association for Promoting the Study of Quaternions. Tait was a prejudiced and pugnacious champion of quaternions as against all other vector algebras, and he infected with his enthusiasm quite a considerable number of people. MacFarlane, in the land of Willard Gibbs, shook off most of this obsession, but there are traces of it even in these addresses, as on p. 45, where he says "most analysts are still crawling in Flatland," after a reference to Hamilton's application of quaternions to three-dimensional space. One might have thought this a place for some reference to Grassmann, whose calculus applies to space of any number of dimensions; not so, and although the index gives twenty-three references to Hamilton and fifteen to Tait, Grassmann is not so much as mentioned.

Apart from this blemish, the lectures deserve the warmest praise. In the first place, the list is truly representative, consisting of Peacock, De Morgan, Hamilton, Boole, Cayley, Clifford, H. J. S. Smith, Sylvester, Kirkman, and Todhunter. A few remarks may be offered on these worthies, each in his turn, and as each lecture suggests a reflection.

George Peacock will always be associated with the "principle of equivalent forms." As a principle it is as dead as a doornail, at any rate as it used to be appealed to; but, all the same, Peacock was one of the first to realise the general character of pure algebra as an abstract symbolism with more or less arbitrary fundamental rules. More than this, he was able, by his position at Cambridge, to make a vast improvement in the study of mathematics there. It was in his time that Leibniz's notation in the differential calculus obtained official recognition in England, partly owing to the efforts of the Analytical Society, "the object of which was stated to be to advocate the *d*'ism of the Continent versus the *dot*-age of the university." Peacock's "Examples" and "Symbolical Algebra" are still worth consulting, even apart from their historical interest.

The lecture on De Morgan is very good, but after our recent review of the reprint of the "Budget," we content ourselves with quoting his description of himself as *homo paucarum literarum*, apparently as a man who declined to be either F.R.S. or LL.D.[1]

As might be expected, the lecture on Rowan Hamilton is well-informed and appreciative, though the reference to his work in dynamics is meagre indeed as compared with the account of his calculus of quaternions. It may be noted that both Salmon and Cayley attended Hamilton's first course of lectures on quaternions.

George Boole, in some ways, is typically English. He may fairly be called the inventor of symbolic logic, and his work on the so-called symbolical method of solving differential equations is that of a pioneer. His predecessor is Peacock, and we may be proud to think that among his successors are Russell and Whitehead, even if the former, in a fit of just indignation, should become an American citizen. MacFarlane's comments on Boole's logical calculus are, technically, the weakest things in his course; on pp. 57–58 he shows that he has not appreciated the modern meaning of "class," and pp. 59–62 are simply "obfuscation," except to a man who cannot improve on the old Euler diagrams.

Cayley comes next, and the gem of the lecture is Clerk Maxwell's poem on the occasion of Cayley's portrait being presented; we cannot help quoting a stanza, if only to show that *some* mathematicians appreciate the witchery of words:—

> First, ye Determinants, in ordered row
> And massive columns ranged, before him go,
> To form a phalanx for his safe protection.
> Ye powers of the *n*th root of -1!
> Around his head in endless cycles run,
> As unembodied spirits of direction.

Cayley's presidential address to the British Association receives a proper amount of attention; oddly enough, Cayley either never read v. Staudt's "Geometrie der Lage" or did not appreciate it, for he seems to have died without realising an "imaginary point" as an actual geometric entity, although he did so much to found the projective theory of metrics. Cayley's kindness and courtesy and help to young mathematicians are duly recorded.

Clifford, owing to his early death, is an unsolved problem. All his mathematical work is brilliant, and, considering his years, original; but his philosophy was as bad as Herbert Spencer's, if not worse, and his cocksureness was irritating, even to his friends. But the author of "Commonsense of the Exact Sciences" deserves immortality, even though (or because) we agree with MacFarlane where he says: "The 'Phædo' of Plato is more satisfying to the mind than the 'Unseen Universe' of Tait and Stewart."

If we were asked to name the Admirable Crichton among British mathematicians, we

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[1] And, we may add, who was accustomed to spell *littera* with one *t*.

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should hesitate between Clerk Maxwell and H. J. S. Smith. Both are mathematicians of the first rank; both are cultured, witty, and childlike; one has all the virtues of the Irishman, the other all those of the Scot. Smith is the more elegant and careful writer; Maxwell is in closer contact with Nature, and possibly has done more to raise her mysterious veil. But Smith's very aloofness, his fondness for what "has no possible practical application," may only mean that he approached the sanctuary by a different road. Of his mordant wit the lecturer gives various samples; he even has the shameless audacity to quote: "—— sometimes forgets that he is only the editor, and not the author, of Nature." Smith's practical common sense, shown in dealing with university and college affairs, illustrates the fact that a mathematician is not always a nincompoop outside the range of his science.

Sylvester is one of the many Jews who have distinguished themselves as pure mathematicians. Self-conceited, irritable, careless as he was, he was eminently original, inspiring, and generous. His unbroken friendship with Cayley is no doubt mainly a credit to the latter, but it is very touching; and although Sylvester was not a model teacher he was stimulating, and had great influence on the best of his hearers. MacFarlane's account of him is, as it should be, both amusing and pathetic; it contains, among other things, Sylvester's brilliant retort to Huxley's depreciation of mathematics; this was one of the few cases in which Huxley was conclusively refuted.

The remaining two lectures are in some ways the most valuable of the ten, especially that on Kirkman. We wonder how many of our readers ever heard of Kirkman and his work; yet he was really a very brilliant mathematician, although comparatively unknown—partly from his own fault, partly from that of others. He used to send scores of ingenious problems to the *Educational Times* (many of them in doggerel verse); these would be quite worth looking up. Besides this, he did some very important work on the classification of polyhedra; the result was communicated to the Royal Society, and we are told here (p. 127) that only two of the twenty-one sections were published in the Philosophical Transactions. If this is true, it is little short of a scandal, and the rest of the MS. should be sent to Prof. Burnside, as the subject is closely connected with group-theory. We are also informed that there are papers on groups by Kirkman embedded in the Proceedings of the Manchester Philosophical Society [the R.S. subject index, p. 65, gives references to vols. i., iii., iv. (1862–65) and to vols. iv., v. of the later series (1891–92)]. Current English text-books on the subject give no reference to Kirkman at all; yet our lecturer says: "So far as British contributors are concerned, Kirkman was the first and still remains the greatest." Whether this is true or not, the matter requires investigation.

On p. 132 we have Kirkman's delightful paraphrase of Spencer's definition of evolution, and a reference to his work on knots; and on p. 133 his neat little problem:—

Baby Tom of baby Hugh
The nephew is and uncle too;
In how many ways can this be true?

which we leave for our readers to solve. The lecture ends with a quotation from one of Kirkman's letters: "What I have done in helping busy Tait in knots is, like the much more difficult and extensive things I have done in polyhedra or groups, not at [all] likely to be talked about intelligently by people so long as I live. But it is a faint pleasure to think it will one day win a little praise."

All of us remember Todhunter as a coach and the author of text-books which in their time were thought the embodiment of perfection and are now unduly depreciated. But Todhunter was much more than a writer of text-books; his mathematical histories are deservedly accounted classics, and in them he was able to display his learning, accuracy, and acumen. We are very glad that a lecture was devoted to him, and that it is so sympathetic. Of course, we have the famous passage on experimental science, with its doctrine of taking everything on the word of "a clergyman of mature knowledge, recognised ability, and blameless character," but we have much more than that. Isaac had no ear for music, but he had a sort of dry humour of his own, as when he quotes the words of a Tripos candidate who was ploughed: "If there had been fairer examiners and better papers I should have passed; I knew many things that were not set."

The book ends with a quotation from Prof. (J. E. B.?) Mayor: "Todhunter had no enemies; for he neither coined nor circulated scandal; men of all sects and parties were at home with him, for he was many-sided enough to see good in everything. His friendship extended even to the lower creatures. The canaries always hung in his room, for he never forgot to see to their wants." May we all have as good an epitaph!

G. B. M.

THE FRESH-WATER FISHES OF RUSSIA.

Les Poissons des Eaux douces de la Russie. Par L. S. Berg. Pp. xxvii + 563 + 365 text-figures and a map. (Moscow: Department of Agriculture, 1916.)

PROF. BERG'S work on the fresh-water fishes of the Russian Empire, complete in one volume, will be welcomed by all ichthyologists, for the author's knowledge of Palæarctic fishes is unrivalled. In plan this work is more condensed than the very elaborate monograph ("Faune de la Russie: Poissons") on which Prof. Berg was engaged, and of which three parts had already appeared, when in 1914 he gave up the curatorship of fishes in the Imperial Academy of Sciences at Petrograd to become the first professor of ichthyology in the Academy of Agriculture at Moscow.

The book is written entirely in Russian, and

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